



**[4910-13]**

## **DEPARTMENT OF TRANSPORTATION**

### **Federal Aviation Administration**

#### **14 CFR Part 25**

**[Docket No. FAA-2015-0692; Special Conditions No. 25-580-SC]**

### **Special Conditions: Boeing Model 787-9, Dynamic Test Requirements for Single-Occupant Oblique (Side-Facing) Seats with Airbag Devices**

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final special condition; request for comments.

**SUMMARY:** These special conditions are issued for the Boeing Model 787-9 airplane. This airplane has a novel or unusual design feature associated with side-facing, oblique seats. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for occupants of seats installed at an angle of greater than 18 degrees, but substantially less than 90 degrees, to the centerline of the airplane, nor for airbag devices. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** This action is effective on **[insert date of publication in the Federal Register]**. We must receive your comments by **[insert date 45 days after publication]**.

**ADDRESSES:** Send comments identified by docket number FAA-2015-0692 using any of the following methods:

- *Federal eRegulations Portal:* Go to <http://www.regulations.gov/> and follow the online instructions for sending your comments electronically.
- *Mail:* Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE., Room W12-140, West Building Ground Floor, Washington, DC, 20590-0001.
- *Hand Delivery or Courier:* Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.
- *Fax:* Fax comments to Docket Operations at 202-493-2251.

*Privacy:* The FAA will post all comments it receives, without change, to <http://www.regulations.gov/>, including any personal information the commenter provides. Using the search function of the docket Web site, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the Federal Register published on April 11, 2000 (65 FR 19477-19478), as well as at <http://DocketsInfo.dot.gov/>.

*Docket:* Background documents or comments received may be read at <http://www.regulations.gov/> at any time. Follow the online instructions for accessing the docket or go to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

**FOR FURTHER INFORMATION CONTACT:** Jeff Gardlin, Airframe and Cabin Safety, ANM-115, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington 98057-3356; telephone 425-227-2136; facsimile 425-227-1149.

**SUPPLEMENTARY INFORMATION:**

The FAA has determined that notice of, and opportunity for prior public comment on, these special conditions are impracticable because these procedures would significantly delay issuance of the design approval and thus delivery of the affected airplane.

The FAA therefore finds that good cause exists for making these special conditions effective upon publication in the **Federal Register**.

**Comments Invited**

We invite interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the special conditions, explain the reason for any recommended change, and include supporting data.

We will consider all comments we receive by the closing date for comments. We may change these special conditions based on the comments we receive.

**Background**

On July 5, 2009, The Boeing Company applied for an amendment to Type Certificate No. T00021SE to include the new Model 787-9 airplane. The Model 787-9, which is a derivative of the Model 787 airplane currently approved under Type Certificate No. T00021SE, is a wide-body twin-jet with wing-mounted engines. It has a 420-passenger capacity, a maximum takeoff weight of 553,000 lb, and is equipped with two Rolls-Royce Trent T1000 or General Electric GENx engines.

Amendment 25-15 to part 25, dated October 24, 1967, introduced the subject of side-facing seats and a requirement that each occupant in a side-facing seat must be protected from head injury by a safety belt and a cushioned rest that will support the arms, shoulders, head, and spine.

Subsequently, Amendment 25-20, dated April 23, 1969, clarified the definition of sideward-facing seats to require that each occupant of a seat that is positioned at more than an 18-degree angle to the vertical plane containing the airplane centerline must be protected from head injury by a safety belt and an energy-absorbing rest that supports the arms, shoulders, head, and spine; or by a safety belt and shoulder harness that prevents the head from contacting injurious objects. The FAA concluded that a maximum 18-degree angle would provide an adequate level of safety based on tests that were performed at that time, and thus adopted that standard.

Part 25 was amended June 16, 1988, by Amendment 25-64, to revise the emergency-landing conditions that must be considered in the design of the airplane. Amendment 25-64 revised the static-load conditions in § 25.561, and added a new § 25.562 that required dynamic testing for all seats approved for occupancy during takeoff and landing. The intent of Amendment 25-64 is to provide an improved level of safety for occupants on transport-category airplanes. Because most seating is forward-facing on transport-category airplanes, the pass/fail criteria developed in Amendment 25-64 focused primarily on these seats. As a result, the FAA issued Policy Memorandums ANM-03-115-30, “Side-facing Seats on Transport Category Airplanes,” and PS-ANM-100-2000-00123 “Guidance for Demonstrating Compliance with Seat Dynamic Testing for Plinths and Pallets,” to provide the additional guidance necessary to demonstrate the level of safety required by the regulations for fully side-facing seats.

To reflect current research findings, the FAA developed a methodology to address all fully side-facing seats (i.e, seats oriented in the airplane with the occupant facing 90 degrees to the direction of airplane travel) and has documented those requirements in a set of proposed new special conditions. The FAA issued Policy Statement PS-ANM-25-03-R1 to document the injury criteria associated with neck and leg injuries for fully side-facing seats that will be used in special conditions issued after the implementation of the policy.

The criteria described in the above policy statements were written for fully side-facing seats and do not fully address the complex occupant-loading conditions introduced by a seat that is at an oblique angle to the centerline of the airplane. The Model 787-9 business-class seat installation is novel such that the current Model 787 side-facing seat special conditions do not adequately convey occupant protection expectations for an oblique-seat installation. Therefore, the configuration Boeing proposes requires new special conditions.

### **Type Certification Basis**

Under the provisions of Title 14, Code of Federal Regulations (14 CFR) 21.101, Boeing must show that the 787-9, as changed, continues to meet the applicable provisions of the regulations listed in Type Certificate No. T00021SE, or the applicable regulations in effect on the date of application for the change, except for earlier amendments as agreed upon by the FAA. The regulations listed in the type certificate are commonly referred to as the “original type-certification basis. ”

The regulations listed in T00021SE are as follows:

The type-certification basis for the Model 787-9 airplane is 14 CFR part 25, effective February 1, 1965, as amended by Amendments 25-1 through 25-128, except § 25.795, Security Considerations, at Amendment 25-106; and § 25.125, Landing, at Amendment 25-108.

In addition, the certification basis includes certain special conditions, exemptions, or later amended sections of the applicable part that are not relevant to these special conditions.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Boeing Model 787-9 airplane because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, the special conditions would also apply to the other model.

In addition to the applicable airworthiness regulations and special conditions, the Boeing Model 787-9 airplane must comply with the fuel-vent and exhaust-emission requirements of 14 CFR part 34, and the noise-certification requirements of 14 CFR part 36.

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type-certification basis under § 21.101.

### **Novel or Unusual Design Features**

The Boeing Model 787-9 airplane will incorporate the following novel or unusual design features:

Installation of Zodiac Seats France Cirrus III model oblique business-class passenger seats manufactured by Zodiac Seats UK, which are seats installed at an angle of 30 degrees to the airplane centerline. These seats will include airbag devices for occupant restraint and injury protection. This particular design allows for the upper torso to align with the impact vector, but

may restrict the knees/legs from fully aligning. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for occupants of seats installed in the proposed configuration.

To provide a level of safety equivalent to that afforded to occupants of forward- and aft-facing seats, additional airworthiness standards, in the form of special conditions, are necessary. Although we have issued side-facing-seat special conditions applicable to the 787, these existing special conditions do not fully address the complex occupant-loading conditions introduced by a seat that is at an oblique angle to the centerline of the airplane. Special Conditions 25-458-SC, “Boeing Model 787 Series Airplanes; Single-place Side-facing Seats with Inflatable Lapbelts,” apply to fully side-facing (90 degree) seats installed on the 787. Special Conditions 25-552-SC, “Boeing Model 787-9, Side-Facing Seats,” were applicable to a specific 49-degree oblique seat installation, and do not contain sufficient criteria for general oblique seat installations.

Boeing is installing airbag devices on these seats, either in the lapbelts or mounted in the structure around the seats. Airbag devices installed in lapbelts on the 787 are addressed by Special Conditions 25-431-SC, “Boeing Model 787 Series Airplanes; Seats With Inflatable Lapbelts.” We are currently developing special conditions to apply to structure-mounted airbag devices installed on the 787.

## **Discussion**

The business-class seating configuration proposed by Boeing is unique due to the seat installation at a 30-degree angle to the airplane centerline. Special Conditions 25-458-SC and 25-552-SC were not intended to address this configuration, nor is this configuration specifically addressed by Policy Statement PS-ANM-25-03-R1 (which is intended to address fully side-facing seats, i.e., 90-degree installation angle). However, we believe the occupant-injury criteria

conveyed in this policy statement is applicable to this type of configuration as it applies to evaluating neck injuries. Due to the unique seat-installation angle, these special conditions also include spinal-loading injury criteria.

These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

### **Applicability**

As discussed above, these special conditions are applicable to the Boeing Model 787-9 airplane. These special conditions can be applied to oblique seats installed at an angle greater than 18 degrees but less than 46 degrees to the vertical plane containing the airplane centerline. Should Boeing apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well. The angle of installation and detailed design features will determine the nature of the occupant response. The FAA will amend these special conditions or issue new special conditions, should unusual occupant response in the required dynamic tests, or additional research into occupant-injury mechanisms, indicate these special conditions are inadequate. Any future special conditions would include due public notice.

### **Conclusion**

This action affects only certain novel or unusual design features on one model of airplane. It is not a rule of general applicability.

Under standard practice, the effective date of final special conditions would be 30 days after the date of publication in the Federal Register; however, as the certification date for the



Boeing Model 787-9 airplane is imminent, the FAA finds that good cause exists to make these special conditions effective upon publication in the **Federal Register**.

### **List of Subjects in 14 CFR Part 25**

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

### **The Special Conditions**

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type-certification basis for Boeing Model 787-9 airplanes modified by Boeing.

#### ***Side-Facing Seats Conditions***

In addition to the requirements of § 25.562:

1. **Existing Criteria:** Compliance with §25.562(c)(5) is required, except that, if the anthropomorphic test device (ATD) has no apparent contact with the seat/structure but has contact with an inflatable restraint, a head-injury criterion (HIC) unlimited score in excess of 1000 is acceptable, provided the HIC15 score for that contact is less than 700.
2. **Body-to-Wall/Furnishing Contact:** If a seat is installed aft of structure (e.g., an interior wall or furnishing) that does not provide a homogenous contact surface for the expected range of occupants and yaw angles, then additional analysis and/or test(s) may be required to demonstrate that the injury criteria are met for the area which an occupant could contact. For example, if different yaw angles could result in different inflatable-restraint performance, then additional analysis or separate test(s) may be necessary to evaluate performance.

### 3. Neck Injury Criteria:

The seating system must protect the occupant from experiencing serious neck injury. The assessment of neck injury must be conducted with the inflatable restraint activated unless there is reason to also consider that the neck-injury potential would be higher below the inflatable-restraint threshold.

- a. The  $N_{ij}$  must be below 1.0, where  $N_{ij} = F_z/F_{zc} + M_y/M_{yc}$ , and  $N_{ij}$  intercepts limited to:
  - i.  $F_{zc} = 1530$  lb for tension
  - ii.  $F_{zc} = 1385$  lb for compression
  - iii.  $M_{yc} = 229$  lb-ft in flexion
  - iv.  $M_{yc} = 100$  lb-ft in extension
- b. In addition, peak  $F_z$  must be below 937 lb in tension and 899 lb in compression.
- c. Rotation of the head about its vertical axis relative to the torso is limited to 105 degrees in either direction from forward-facing.
- d. The neck must not impact any surface.

### 4. Spine and Torso Injury Criteria:

- a. The shoulders must remain aligned with the hips throughout the impact sequence, or support for the upper torso must be provided to prevent forward or lateral flailing beyond 45 degrees from the vertical during significant spinal loading.
- b. Significant concentrated loading on the occupant's spine, in the area between the pelvis and shoulders during impact, including rebound, is not acceptable. During this type of contact, the interval for any rearward (X direction) acceleration exceeding 20g must be less than 3 milliseconds as measured by the thoracic

instrumentation specified in 49 CFR part 572, subpart E, filtered in accordance with SAE International (SAE) J211-1.

- c. Occupant must not interact with the armrest or other seat components in any manner significantly different than would be expected for a forward-facing seat installation.
5. Longitudinal test(s), as necessary, must be performed with the FAA Hybrid III ATD, undeformed floor, most-critical yaw case(s) for injury, and with all lateral structural supports (armrests/walls) installed. For the pass/fail injury assessments, see the criteria listed in special conditions 1 through 4, above.

**Note:** Boeing must demonstrate that the installation of seats via plinths or pallets meets all applicable requirements. Compliance with the guidance contained in FAA Policy Memorandum PS-ANM-100-2000-00123, dated February 2, 2000, titled “Guidance for Demonstrating Compliance with Seat Dynamic Testing for Plinths and Pallets,” is acceptable to the FAA.

***Inflatable Lapbelt Conditions***

If inflatable lapbelts are installed on single-place side-facing seats, the inflatable lapbelt(s) must meet Special Conditions 25-431-SC.

Issued in Renton, Washington, on April 14, 2015.

*/s/ Michael Kaszycki*

Michael Kaszycki  
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Aircraft Certification Service  
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